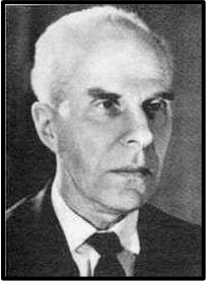


ZSU-23-4 Shilka



Shilka (is named for a river in Eastern Russia) was the first self-contained, mobile, radar-guided AAA (anti-aircraft artillery) system. It was designed by OKB-40 under the leadership of N.A. Astov. It was fully NBC (Nuclear Biological Chemical) protected by a filtered over-pressurization system. The Soviet Union fielded the first version in 1964. The Shilka was constantly improved during its lifetime resulting in the ZSU-23-4V, V1, M1, M2 and M3 variants.



It was widely exported and participated in several wars which made one of the most iconic weapon system of the Cold War especially because it was so successful in the 4th Arab-Israeli (Yom Kippur) war in 1973.

In 1973 the strike fighters generally employed their weapons at low level because internal guns, unguided rockets and bombs achieved the necessary accuracy only at very close range and low level. Regardless the

kinematics (ballistic) range of the 23 mm gun, the effective range was smaller than the gun of the predecessor ZSU-57-2 – only 2500 meter – the accuracy and efficiency of the new AAA system totally outclassed the previous generation. This higher combat capability was supported by the radar target tracking, the ballistic “computer” (mechanical fire solution calculator) and the very high rate of fire. The cumulative fire rate of the 4x23 mm gun was 3400 round/min. The total ammo capacity of the vehicle is 2000 round in theory the full load can be fired in a very long continuous salvo. In reality after 120-150 round salvos about 10-15 second cooling was required.

The Shilka was capable of firing on the move. The chassis of the ZSU-23-4 is the same as the PT-76 amphibious recon tank but the ZSU-23 does not have this capability.

The fire control radar operates on 2 cm wavelength it can detect a MiG-21 size target from about 13 km, the maximal possible target tracking range is 20 km. The fire control system is able to perform target acquisition but only in sector search mode and with very limited capability because of the only 2 degree wide pencil beam. During target acquisition the pencil beam of the antenna mechanically scans a degree sector vertically (elevation). The system has the best efficiency in case it gets coordinates from the 9S482 BTR-60 PU-12 Mobile Air Defense Command Post via radio. The CP got the coordinates from higher level radars via digital datalink.

Shilka has the following firing modes:¹

1. Full Automatic Tracking of an aerial target with the 1RL33 RPK-2 (Gun Dish) radar in angle and range. Firing solution is provided by the 1A7 SRP mechanical fire solution calculator.
2. Optical angle tracking of an aerial target, while the 1RL33 RPK-2 (Gun Dish) radar is measuring the target range only. (used in case of angle jamming conditions) Firing solution is provided by the 1A7 SRP mechanical fire solution calculator.
3. ZU (memory) mode. In case of losing the target, the radar is automatically following its predicted path.

¹ http://www.mediafire.com/download/y5s92qmc18jdkms/SAMSim_docs_150803.rar

4. Optical aiming used against an aerial target. This is only a backup mode in case of malfunction of either the 1RL33 RPK-2 (Gun Dish) radar or the 1A7 SRP mechanical fire solution calculator or GAG (gyroscope) unit.
5. Fire against ground targets.

ammo flight time	Distance	Velocity	Drop	Dispersion	Penetration
s	m	m/s	m	m	mm
0s	0	980	0 m	0	38
0.2	200	860	0.2	0.4	32
0.6	500	700	2	1.2	25
1.4	1000	520	10	2.8	19
2.5	1500	400	30	5	16
4.17	2100	310	85	8	14
5.5	2500	280	150	11	14
11	3800	210	600	22	13

The 23 mm Ammunition Ballistics calculated by the 1A7 SRP

Maximal target speed of the Shilka is 450 m/s, maxima target distance is 2.5 km up to 1500 meter altitude. In Afghanistan a modified version of the ZSU-23-4 was used because of its very high turret elevation which make possible to provide fire support in mountainous environment where tanks and APC and IFV vehicles were unable to do that.

Not only the Soviet Union and other Warsaw Pact member had self-propelled AAA system but the NATO also used them in greater quantity. Such system is the German Flakpanzer Gepard equipped with 2x35 cannon, the French AMX-13 DCA 302 which based on the chassis of the AMX-13 tank or the American M163 PIVADS which used the much smaller 20 mm caliber M61 Vulcan gun but with much higher fire rate but with less range. The conception of the South Korean K-30 BIHO is also similar but what it makes unique the amphibious capability.



Above left is the Flakpanzer Gepard on right is the AMX-13 DCA 30.

² <http://www.tanks-encyclopedia.com/coldwar/France/AMX-13-DCA/>